

CLAIMS

What is claimed is:

1 1. An apparatus, comprising:
2 an active region of an optical waveguide disposed in a semiconductor
3 layer, the active region including a p doped region and an n doped region;
4 and
5 an insulating region disposed in the semiconductor layer surrounding
6 the active region in the semiconductor layer, the insulating region
7 electrically isolating the active region of the optical waveguide from a passive
8 region of the optical waveguide disposed in the semiconductor layer,
9 wherein an optical beam is to be directed through the optical waveguide and
10 through the active region is to be phase shifted in response to a modulated
11 charge region in the active region in the optical waveguide.

1 2. The apparatus of claim 1 wherein the active region further
2 comprises an intrinsic region of semiconductor material adjoining and
3 disposed between the p doped and n doped regions.

1 3. The apparatus of claim 1 wherein substantially all of the
2 modulated charge region in the active region is along an optical path of the
3 optical beam.

1 4. The apparatus of claim 1 wherein the p doped and n doped
2 regions are substantially adjoining the insulating region.

1 5. The apparatus of claim 2 wherein substantially none of the
2 intrinsic region of the semiconductor material is disposed between the
3 insulating region and the p doped or n doped regions.

1 6. The apparatus of claim 2 wherein the p doped, intrinsic and n
2 doped regions are included in a p-i-n diode included in the active region.

1 7. The apparatus of claim 2 wherein the optical beam is to be
2 directed through the intrinsic region of the active region, wherein the optical
3 beam is to be phase shifted in response to the modulated charge region in
4 the intrinsic region.

1 8. The apparatus of claim 2 wherein the p doped and n doped
2 regions disposed outside an optical path of the optical beam through the
3 active region.

1 9. The apparatus of claim 8 wherein the optical waveguide
2 comprises a rib waveguide having a rib portion and a slab portion, wherein
3 the p doped and n doped regions are disposed at opposite ends of the slab

4 portion outside the optical path of the optical beam through the active
5 region.

1 10. The apparatus of claim 1 wherein the insulating region
2 surrounding the active region comprises one of silicon nitride, oxide, SiO₂ or
3 air.

1 11. The apparatus of claim 1 wherein the semiconductor layer
2 comprises silicon.

1 12. The apparatus of claim 1 wherein the modulated charge region
2 in the active region in the optical waveguide is coupled to modulated in
3 response to current injection in the active region between the p doped and n
4 doped regions.

1 13. A method, comprising:
2 directing an optical beam through a first passive region of an optical
3 waveguide disposed in a semiconductor layer;
4 directing the optical beam from the first passive region through an
5 insulating region disposed in the semiconductor layer into an active region
6 of the optical waveguide, the insulating region surrounding the active
7 region;

8 phase shifting the optical beam in response to a charge modulated
9 region disposed in the active region of the optical waveguide; and
10 directing the optical beam from the active region through the
11 insulating region into a second passive region of the optical waveguide, the
12 active region electrically isolated from the first and second passive regions of
13 the optical waveguide.

1 14. The method of claim 13 wherein phase shifting the optical beam
2 comprises modulating a charge modulated region disposed in the active
3 region in the semiconductor layer.

1 15. The method of claim 14 further comprising confining with the
2 insulating region substantially all of the charge modulated region in the
3 active region to be along an optical path of the optical beam through the
4 active region.

1 16. The method of claim 14 wherein modulating the charge
2 modulated region comprises injecting current in the active region between p
3 doped and n doped regions disposed in the active region in the
4 semiconductor layer.

1 17. The method of claim 16 further comprising reducing with the
2 insulating region current leakage of the injected current outside an optical
3 path of the optical beam through the active region.

1 18. The method of claim 16 wherein phase shifting the optical beam
2 comprises directing the optical beam through an intrinsic region of
3 semiconductor material in the semiconductor layer adjoining and disposed
4 between the p doped and n doped regions.

1 19. The method of claim 18 wherein directing the optical beam
2 through the intrinsic region comprises directing the optical beam along an
3 optical path through the active region outside of the p doped and n doped
4 regions.

1 20. A system, comprising:
2 an optical transmitter to transmit an optical beam;
3 an optical receiver; and
4 an optical device optically coupled between the optical transmitter
5 and optical receiver, the optical device including an optical waveguide
6 disposed in a semiconductor layer, the optical waveguide including:
7 an active region of the optical waveguide disposed in a
8 semiconductor layer, the active region including a p doped region and
9 an n doped region; and

10 an insulating region disposed in the semiconductor layer
11 surrounding the active region in the semiconductor layer, the
12 insulating region electrically isolating the active region of the optical
13 waveguide from a passive region of the optical waveguide disposed in
14 the semiconductor layer, wherein the optical beam transmitted from
15 the optical transmitter is to be directed through the optical waveguide
16 and through the active region to be phase shifted in response to a
17 modulated charge region in the active region in the optical waveguide,
18 wherein the optical receiver is coupled to receive the phase shifted
19 optical beam from the optical device.

1 21. The system of claim 20 wherein the active region further
2 comprises an intrinsic region of semiconductor material adjoining and
3 disposed between the p doped and n doped regions.

1 22. The system of claim 20 wherein the p doped and n doped
2 regions are substantially adjoining the insulating region.

1 23. The system of claim 21 wherein substantially none of the
2 intrinsic region of the semiconductor material is disposed between the
3 insulating region and the p doped or n doped regions.

1 24. The system of claim 21 wherein the optical beam is to be
2 directed through the intrinsic region of the active region, wherein the optical
3 beam is to be phase shifted in response to the modulated charge region in
4 the intrinsic region

1 25. The system of claim 21 wherein the p doped and n doped
2 regions disposed outside an optical path of the optical beam through the
3 active region.

1 26. The system of claim 20 further comprising an optical splitter
2 coupled between the optical transmitter and the optical device, the optical
3 splitter coupled to receive the optical beam and split the optical beam into a
4 plurality of optical beams output from the optical splitter, wherein the
5 optical beam received by the optical device is one of the plurality of optical
6 beams output from the optical splitter.

1 27. The system of claim 26 wherein the optical waveguide is one of
2 a plurality of optical waveguides disposed in the semiconductor layer,
3 wherein each of the plurality of waveguides is substantially similar to one
4 another, wherein each of the plurality of waveguides is coupled to the
5 optical splitter to receive a respective one of the plurality of optical beams
6 output from the optical splitter.

1 28. The system of claim 27 further comprising an optical coupler
2 coupled between the plurality of waveguides and the optical receiver, the
3 optical coupler to receive the plurality of optical beams output from the
4 optical splitter through the plurality of waveguides, the optical coupler to
5 combine the plurality of optical beams output from the optical splitter and
6 selectively direct the optical beam to the optical receiver.

1 29. The system of claim 28 wherein the optical receiver is one of a
2 plurality of optical receivers optically coupled to the optical coupler, wherein
3 each of the plurality of optical beams is selective coupled to receive the
4 optical beam from the optical coupler.

1 30. The system of claim 28 wherein the optical transmitter is one of
2 a plurality of optical transmitters, each of the plurality of optical
3 transmitters to transmit a respective optical beam, each respective optical
4 beam to be split by the optical splitter into a plurality of optical beams to be
5 directed through the plurality of waveguides.